TIDAL POWER CORPORATION

ANNUAL REPORT

1987-1988

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NOVA SCOTIA

TIDAL POWER CORPORATION

REPORT BY THE PRESIDENT

ON THE AFFAIRS OF THE CORPORATION

FOR THE YEAR ENDED MARCH 31, 1988

As a prerequisite to large-scale tidal development in the Bay of Fundy, solutions will be required to two problems: retiming of output to provide firm power, and means of reducing fish mortality to an acceptable level. During the year under review, the Corporation's objective was to resolve these problems and considerable progress was made.

Fish Mortality and Diversion

Further investigations relating to fish mortality were undertaken during the year. The work was supported by Energy, Mines & Resources Canada and by the Corporation. Tests were conducted at the Fourth Lake generating station, made available by the kind co-operation of Nova Scotia Power Corporation. It was found that the mortality suffered by test fish was much higher than that of fish passing the turbine in the natural course of events and not subject to any human interference. In mortality studies, it is customary to reduce the mortality estimate to allow for the effects of handling. However, the results obtained at Fourth Lake strongly suggest that accepted methods may lead to a gross overestimate of mortality.

If this finding is confirmed, the requirements for fish passage in river hydro applications may be less stringent in future. Nevertheless, because fish are likely to make multiple passages through tidal plants as opposed to single migratory passage through river hydro, the Corporation is still of the opinion that successful means of fish diversion will have to be found and demonstrated in order to secure environmental approval for a large-scale tidal plant.

Physical means of fish diversion have been used with considerable success at many hydro plants. The more effective designs are expensive. Travelling screens would probably cost about $4 million for each turbine of a tidal plant and would be subject to severe fouling and corrosion problems. The Corporation therefore decided to investigate behavioural devices such as light, sound and air bubbles.

Because of its knowledge of such devices, Ontario Hydro was engaged by the Corporation to test the efficiency of such devices at Annapolis. Nova Scotia Power Corporation made the site available, provided program management and absorbed at-site costs. The work was done in the summer and fall of 1987.

Results indicated that high-intensity, low frequency sound was most effective in diverting adult shad away from the turbine intake. Results were inconclusive for juvenile fish, but a separate trial, undertaken by NSPC at Hell's Gate generating station, showed almost complete effectiveness in diverting juveniles to the fish ladder.

Further work, planned for the ensuing fiscal year, will seek to secure quantified data, but even without such data it appears that an effective and economical means of fish diversion is in sight.

It should be noted that published figures purporting to indicate high mortality of juvenile fish at the Annapolis plant were not corrected to remove the mortality imposed by recapture netting and in the light of Fourth Lake results were probably about three times actual mortality. From all it has been able to learn, the Corporation believes that fish mortality at Annapolis is moderately low and poses no threat to fish stocks.

Retiming

The two potentially economic sites for tidal power development, A8 in Cumberland Basin and B9 in Minas Basin, would both have relatively large energy outputs, all or a considerable part of which would have to be marketed initially in the north-eastern United States. Market research undertaken as part of the Stage 1 Study in 1984 indicated that the New England Power Pool (NEPOOL) would require firm capacity in any future imports from Canada. By contrast, tidal plants of economical design produce energy intermittently in the form of one or two pulses per tide. In order to produce a product acceptable to NEPOOL, it would therefore be necessary to store some of the energy produced by the tidal plant and to deliver the stored energy at times of peak customer demand. The word retiming is used in this report to indicate the process of storage of energy when yielded by the tides and delivery to meet customer demands.

There are many methods of energy storage including such relatively undeveloped techniques as inertial, magnetic and chemical storage. However, the Corporation restricted its cosideration to methods supported by favourable commercial experience. The best of such methods available to the Corporation appeared to be compressed air energy storage (CAES).

The CAES method involves using surplus energy to compress air which is conveniently stored in underground caverns. To recover the stored energy, the compressed air is supplied to combustion turbines. A suitable fuel is also supplied to the turbine. The turbine turns a generator and electricity is produced. While such a system has been operating satisfactorily in Germany for a number of years, nothing was known about its adaptation to a tidal plant. With support from Energy, Mines & Resources Canada, research on this subject was conducted by Canadian Atlantic Power Group (CAPG).

It had been conjectured that compressors might be substituted for generators in the tidal plant. However, this appears uneconomic and might come too close for comfort to the limits of mechanical design. The preferred arrangement is to leave the tidal plant design unchanged and to transmit electric energy from the tidal plant to a completely separate CAES plant.

To preserve maximum flexibility, CAPG advocates compressors in the CAES plant separate from the gas turbines and generators. It appears economic to provide sufficient storage to level out variations of tidal plant output over tidal neaps and springs.

In consultation with NEPOOL, it is envisaged that the retimed output would be in the form of a 12-hour block each day except Saturday and Sunday. For A8, the required CAES capacity would be 1,400 MW, the annual output 4,305 GWh, and the fuel input about 17 million MBtu per year. The fuel input is about one-third the amount required for conventional gas turbine generation. At least one site offering suitable storage of the size required has been tentatively identified.

A CAES plant of the type described above would cost about $1,313 million, and the storage $130 million, both in December 31, 1987 dollars, excluding interest during construction. Based on CAPG results, the Corporation concludes that CAES is technically feasible and, as expected, more economical than pumped storage.

However, it is by no means certain that the retimed output of A8 would be economically competitive. Cost per KWh is expected to be between 9¢ and 12¢ per KWh in December 1987 constant dollars, depending on interest and inflation rates and fuel costs. The output is a quality product, but whether the quality premium would justify the cost premium remains to be determined.

Impacts in the United States

During the year and assisted by the U. S. National Oceanic and Atmospheric Administration, the Corporation entered into discussion with U. S. scientists to identify research needs relating to environmental impacts on the Gulf of Maine coast. Such impacts would, in the Corporation's opinion, be minor for A8 but would be substantial for B9. If the larger and far more economic site is ever to be developed, these impacts will have to be determined and assessed. From the U. S. point of view, A8 impacts would also need to be assessed before import permits could be issued.

Sedimentation

The muddy waters of the Upper Fundy could lead to sedimentation problems if a tidal plant is built. A sediment model of Minas Basin has been used to make rough predictions but no such work has been undertaken for Cumberland Basin. A preparatory step was taken during the year under review with the design and calibration of a three-dimensional hydrodynamic numerical model of Cumberland, and proposals have been made for a sedimentation study using this model.

It has recently been found that cohesion of sediment on drying flats is as much as 80 times higher than cohesion measured in laboratories. It may be necessary to gain an understanding of this anomaly before reliable results can be obtained from sediment studies.

Economic Status of Tidal Power

The drop in oil prices in 1986 and downward revision of short and medium term price forecasts reduced the apparent economic attractiveness of tidal power. The higher-cost site A8 probably became uncompetitive. While still economically attractive, other valid considerations made it impossible to consider early development of B9.

It is generally considered inevitable that the price of light crude oil will increase in future, perhaps drastically, as non-OPEC reserves are depleted. Probably other fuels will trend in the same direction as they did in the 1970's and '80's. Any considerable escalation of fuel prices above the rate of general inflation would enhance the competitive status of tidal power. Logically, the best time to build a large tidal plant would be before another oil price shock and the inflation it would trigger. However, without any means of accurately predicting the future, development at present would be risky and the Corporation does not advise incurring such risk under present conditions.

Administrative and Financial

Two meetings of the Board of Directors were held during the year.

The Corporation operated substantially within its approved budget. Research expenditures increased by about $83,000 compared to 1986/87, mainly on account of the fish diversion study and administrative and engineering costs were reduced by about $13,000. Audited statements for the year ended March 31, 1988 are appended and form part of this report.

All of which is respectfully submitted as of March 31, 1988.

Ron Barkhouse
President and
Chief Executive Officer

TIDAL POWER CORPORATION

F I N A N C I A L S T A T E M E N T S

MARCH 31, 1988

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AUDITORS' REPORT

To the Chairman and Directors of
Tidal Power Corporation

We have examined the balance sheet of the Tidal Power Corporation as at March 31, 1988 and the statement of income and surplus for the year then ended, and have obtained all the information and explanations we have required. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion and according to the best of our information and the explanations given to us and as shown by the books of the corporation, these financial statements are properly drawn up so as to exhibit a true and correct view of the financial position of the corporation as at March 31, 1988 and the results of its operations for the year then ended in accordance with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

Doane Raymond.

Halifax, Nova Scotia

May 5, 1988

Chartered Accountants

TIDAL POWER CORPORATION

BALANCE SHEET

MARCH 31, 1988

ASSETS	1988	1987
Current		
Cash and short term deposits	$ 10,539	$16,801
Accounts receivable	174,300	12,000
	184,839	28,801
Office furniture, at cost less accumulated depreciation o $4,757 (1987 - $3,689)	16,986	17,954
	$201,825	$46,755
LIABILITIES		
Current		
Payables and accruals	$182,925	$25,536
SURPLUS		
Surplus	18,900	21,219
	$201,825	$46,755

ON BEHALF OF THE BOARD · ·

Director

Director

TIDAL POWER CORPORATION

STATEMENT OF INCOME AND SURPLUS

YEAR ENDED MARCH 31, 1988

	1988	1987
Income		
Province of Nova Scotia (Note 2)	$299,300	$237,000
Interest	1,325	715
	300,625	237,715
Expenses		
Administration, promotion and travel	118,942	130,690
Audit	1,100	1,200
Depreciation - office furniture	1,087	1,007
Directors' fees	1,500	2,000
Legal	4,896	7,342
Research studies (Note 3)	175,419	91,991
	302,944	234,230
Excess of income over (under) expenses	(2,319)	3,485
Surplus, beginning of year	21,219	17,734
Surplus, end of year	$ 18,900	$ 21,219

TIDAL POWER CORPORATION

NOTES TO FINANCIAL STATEMENTS

MARCH 31, 1988

1. The Tidal Power Corporation was established by Chapter 21 of the Statutes of Nova Scotia, 1970-71. Order-in-Council 71-379 proclaimed that Chapter 21 of the Statutes of Nova Scotia 1970-71, the Tidal Power Corporation Act, came into force on the 22nd day of April, 1971.

2. Pursuant to Section 16 of the Tidal Power Corporation Act, funds for the purpose of carrying out the objects and powers of the Corporation were obtained from the Province of Nova Scotia. Income for the current year is $299,300 (1987 - $237,000).

3. Research study expenditures, for the purpose of defining or mitigating impacts of large-scale tidal power development, were comprised of the following:

Fish diversion	$140,032
Headpond fish stocks	14,887
Fish mortality	9,500
Basic research - sedimentation	9,000
Annapolis headpond aerial photography	2,000
	$175,419